Dietary Intakes and Leisure-Time Physical Activity in West Virginians

By: Debra A. Krummel, Ph.D., RD., Paul Gordon, Renee H. H. Newcomer, Ed.D, Xiaojie Lui, M.S., Daniel M. M. Christy, M,P.A., Alan Holmes, M.B.A.

Krummel, D., Gordon, P., Newcomer, R., Lui, X., Christy, D., & Holmes, A. (2001). Dietary Intake and leisure-time physical activity in West Virginians. West Virginia Medical Journal, 97(6), 295-301.

Abstract:
Poor diet and physical inactivity contribute to many chronic diseases in the United States each year Diets low in saturated fatty acids and cholesterol and high in plant foods, i.e., fruits and vegetables, legumes and whole cereals, are protective, Physically active lifestyles are associated with lower risk of cardiovascular diseases, diabetes, obesity and some cancers, To access diet and physical activity levels in West Virginians, we conducted a study which was supported by the West Virginia Bureau for Public Health and the West Virginia University Prevention Research Center (CDC Cooperative Agreement). The purposes of this study were to estimate the proportion of the sample meeting recommendations for chronic disease prevention, and to examine if the individuals who were meeting the Surgeon General's physical activity recommendation for health are also consuming healthier diets, Our results showed that reducing saturated fatty acids and increasing consumption of folate, and increasing consumption of folate, Vitamin E, calcium and fiber are of prime public health importance in West Virginia. Diet and activity levels were modestly related, suggesting that those who adopt a healthy diet also become more active and vice versa. Due to the cross-sectional nature of this data, it is unknown if single- strategy or dual interventions work best. Prospective studies are needed to determine optimal strategies.

Article:
Introduction
In the United States, over 300,000 deaths per year are attributable to poor diet and physical inactivity (1). Diets low in saturated fatty acids and cholesterol and high in plant foods, i,e,, fruits and vegetables, legumes, and whole cereals, are protective, and whole cereals, are protective, Physically active lifestyles are associated with lower risk of cardiovascular diseases, diabetes, obesity, and some cancers. Thus, a primary strategy for reducing the risk of these chronic diseases is a combination of a healthful eating plan and physical activity (2,3).

Despite national recommendations for optimal dietary intakes and physical activity levels to reduce chronic diseases, many Americans fall short of the goal. hi the Continuing Survey of Food Intakes by Individuals (1994-1996), 29% of adult men and 37% of adult women net dietary fat recommendations (30% of calories from fat (4). For dietary fiber, the American diet contains about half of what is recommended (4,5). Physical what is recommended (4,5). Physical activity levels are suboptimal as well, since 25% of adults report no leisure- time physical activity (6).

The purposes of this epidemiological study were to assess diet and physical activity levels in West Virginians, to estimate the proportion of the sample meeting recommendations for chronic disease prevention, and to examine whether people meeting the Surgeon General's physical activity recommendation for health are also consuming healthier diets. For diet comparisons to national standards, we studied six food components significant to public health (food energy, total fat, saturated fatty acids, cholesterol, iron, calcium, and sodium) along with fiber (proxy for grains), vitamins C (proxy for fruit and vegetable intake) and E, and folate for cardiovascular disease prevention (7). For nutrient comparisons between active and inactive individuals, we examined the intake of all of these components as well as the intake of vitamins A, BG and B12. B12. We also studied other nutrient intakes for West Virginians, but these results were not included in this article due to space and they are available on the West Virginia Bureau for Public Health web site (http:\www.dhhr.org).

Methods

A random sample of households. A random sample of households (N 5,600) with telephones in West Virginla was purchased (Survey Sampling, Inc., Fairfield, CT'). Some of these numbers (1,960) were unusable (i,e., businesses, Faxes, etc.). Intravidual variability of saturated fatty acids was utilized to calculate sample size since this nutrient had a population recommendation in the Healthy People 2000 Objectives (8), A total sample of 42() individuals was needed to make gender and age comparisons. To allow for many comparisons, the recruiting goal was set at 1,000 residents of the state who were noninstitutionalized adults over the age of 18 years.

Out of 3,640 calls, 1,243 People agreed ιo ιo Participate in the survey (34% response rate). Respondents were chosen by the birthday method used in the Behavioral Risk Factor Surveillance System (BRFSS) conducted by the West Virginia Bureau of Public Health (9). After explaining the purpose of the study, the interviewers obtained verbal consent and the

Table 1. *Demographic Variable for Total Sample of Participants.*

Category	N*	%
Gender		
Females	567	72
Males	221	28
Age		
< 24 years	57	7
25 - 50 years	507	64
> 50 years	223	28
Income*		
< $30,000	289	38
≥ $30,000	478	62
Education*		
≤ 12 years	328	43
13 - 15 years	210	28
≥ 16 years	223	29
Activity**		
Inactive	141	18
Active	223	28

* Total N is less for education (N = 761) and income (N = 767), since some chose to not answer this question.
** N = 364. Inactive = individuals who report no participation in leisure time physical activity; active = individuals who report engaging in physical activity of at least 5 times per week for a minimum of 30 minutes, and at an intensity of > 3 METS.

respondents' addresses in order to mail the Food Portion visual poster (Nutrition Consulting Enterprises, Framington, MA), MA), which helps individuals describe the size of the portions of food items they consume. Once an individual had agreed to participate and the poster had been mailed to them, they were called for the 24-hour recall period.

As an incentive to participate in the program, respondents were told they would be given their nutrition analyses and general nutrition information at the end of the study, A A total of 788 individuals completed the entire study (788/1,243 = 63% participation rate).

Diet and Physical Activity Assessments

The Consensus Workshop on Dietary Assessment concluded that multiple 24-hour dietary recalls are the preferred dietary assessment method for nutrition-monitoring purposes (10), Twenty-four-hour recalls record the self-reported intake of all foods, beverages, and supplements consumed over a 24-hour period. In the National Health and Nutrition Examination Survey (NHANES) (5), 24-hour recalls were obtained using the University of Minnesota Dietary Nutrition Data Minnesota Dietary Nutrition Data System, which has a standardized interview format (11). We used the same method in this study. Data were collected in the spring and summer of 1997.

The University of Minnesota Nutrition Data System uses a "multiple pass" method to help subjects with memory retrieval. In the first pass, subjects are asked to list all foods and drinks consumed without providing any detail. After a subject has listed all consumed items, the interviewer queries for details on the foods reported (portions, brand names, recipes, etc.) as well as for any additional foods that may have not been recalled in the first pass. In the last pass, the interviewer reads the detailed intake back to the respondent and inquires if anything else was added or anything else consumed. To determine portions, respondents used the Food Portion visual poster previously described, which had been validated for the Framingham study (12).

The 24-hour recall interviews were conducted on every day of the week, and after the dietary questions were completed each day, respondents were asked questions regarding physical activity, osteoporosis, and demographic information, Leisure-time physical activity was measured using the exercise questions from the BRFSS (9), The physical activity questions on the BRFSS survey are designed to obtain information on up to two leisure-time physical activities performed most often within the past month, The questions probe for the type of activity performed, the number of times performed per week or month (frequency), and the number of (frequency), and the number of hours or minutes performed (duration). The intensity requirements for specific activities were estimated on the basis of intensity codes taken from the compendium of physical activities (13).

Utilizing their responses to the questions about physical activity, respondents were classified into the following categories:

1) **inactive**: individuals who report no participation in leisure- time physical activity; and

*Table 2. Mean Nutrient Intake of WV Sample Compared to NHANES III.**

Nutrient	WV Sample Mean	WV Sample Standard Error	NHANES III Mean	NHANES III Standard Error
Energy (kcal)	1939	34.5	2095	18
Carbohydrate (gm)	256	4.6	257	2.6
Protein (gm)	71	1.5	78	0.6
Total Fat (gm)	71	1.8	81	0.9
Carbohydrate (%)	54	0.4	50	0.2
Protein (%)	15	0.2	15	0.1
Total fat (%)	32	0.4	34	0.2
Saturated fat (%)	11	0.2	12	0.1
Cholesterol (mg)	238	7.9	270	4.0
Sodium (mg)	3222	64	3289	33
Dietary fiber (gm)	17	0.36	15	0.17
Vitamin C (mg)	92	3.6	105	2.4
Vitamin E (mg)	8	0.24	9	0.2
Folacin (ug)	271	7.14	275	4.2
Iron (mg)	15	.36	15	0.2
Calcium (mg)	752	18.31	857	11
Zinc (mg)	10	0.23	11	0.14

* National Health and Nutrition Examination Survey III (NHANES III)(1988-91) (5). Means are rounded to the nearest tenth.

2) **active:** individuals who report exercising at least 30 minutes, of moderate activity (> 3 METS where METS are metabolic equivalents; 3 METS are equal to 3 or more times resting metabolism) for five or more days per week, which are the Surgeon General's physical activity recommendations for health (6).

Interviews lasted between 20 and 30 minutes depending upon the complexity of the diet and talkativeness of the respondent, The data were analyzed using the University of Minnesota Nutrition Data System (version 2.9), Statistical analysis was performed using SPSS for Windows (version 9,0, Chicago, IL). Population intake of nutrients were compared to national recommendations. The sample was then divided by activity status, and nutrient intakes were compared using an independent t-test and Levene's test for equality of the variance.

Results

Of the total calls made (3,640), 1,243 people agreed to participate (34% response rate), The low response rate reflects the difficulty of getting people to participate in telephone surveys. Complete diet and physical activity assessments were obtained on 788 individuals (63% participation rate), For the total population, this sample is adequate; however, some subgroups are underrepresented (those under 24 years of age), so our data was compiled by total sample instead of age.

Participants were more often female, within the age group of 25-50 years, of lower income, and had less than a high school education (Table 1). The median age of the sample, 43 years, was not statistically different between genders, For activity levels, 18% (π (π 141) 0 subjects reported no leisure-time physical activity, and 280/c (n = 223) met the Surgeon General's recommendation of moderate exercise for at least 30 minutes, on 5 or more clays per week.

Table 3. ***Percentage of Population Meeting Dietary Recommendations.***

Nutrient	Dietary Recommendations	Number (Total N=788)	Percentage %
Carbohydrate	≥ 50% of Calories	495	63
Protein	10-30 % of Calories	552	70
Total Fat	≤ 30% of Calories	332	42
Saturated Fat	≤ 10% of Calories	358	45
Cholesterol	≤ 300 mg	591	75
Sodium	≤ 3000 mg	420	53
Dietary Fiber	≥ 25 gm	158	20
Vitamin C	≥ 90 mg/men ≥ 75 mg/women	315	40
Vitamin E	≥ 15 mg	82	10
Folate	≥ 400 ug	142	18
Iron	All Men ≥ 10 mg; women over 50 years ≥ 10 mg; women under 50 years ≥ 15 mg	382	48
Calcium	≥ 1000 mg younger ≥ 1200 mg older	284	36
Zinc	≥ 15 mg for men; ≥ 12 mg for women	168	21

Nutrient Intakes

For most nutrients, the variability in intakes is higher in the West Virginia sample than in the NHANES III study (Table 2). This result is predictable given the much smaller sample for West Virginia. The mean intake in both samples was approximately 2,000 Calories. This is the level upon which the Nutrition Facts label on food products is based. The mean caloric intakes for men were 2,501 kcal and 2,478 kcal in the West Virginia and NHANES III samples, respectively, For women, the mean caloric intakes were 1,720 kcal for West Virginia and 1,732 kcal for NHANES III.

The percentage of protein was identical in the both the West Virginia and NHANES Iii samples. What did vary, however, was the percentage of calories from carbohydrate, 54% in WV sample vs. 50% in NHANES III,WV sample vs. 50% in NHANES III, and the percentage of calories from fat, 32% in the WV sample vs. 34% in the

NHANES Ill. Saturated fat intake paralleled fat intake and was lower in the WV sample. Dietary fiber was slightly higher, and calcium, zinc, and Vitamin E intakes were lower in the West Virginia sample.

The guideline net by most of the West Virginia sample was for percentage of calories from protein (70% met) and dietary cholesterol (75% met) (Table 3). Slightly less than two-thirds of the West Virginia sample met the dietary recommendations for percentage of calories from carbohydrate, and approximately one-half met sodium approximately one-half met sodium and iron recommended intakes. Most did not meet recommendations for fat, saturated fat, or fiber. Approximately 40% consumed adequate calcium and Vitamin C. For other micronutrients, very few met recommendations for Vitamin E or folate.

Nutrient intakes of the inactive and active groups are listed in Table 4. The mean caloric intake was approximately 1,800 kcal per day and did not differ between groups (p .44). Percentage of calories from protein was higher among the active (16%) than the inactive (14%) group. No significant group differences were observed for fat or carbohydrate intake.

Percentage of calories from fat was lower in the active group than the inactive, but did not reach significance (p = .07). Significantly higher amounts of Vitamin A A (1,052 vs. 792 mcg RE), Beta-carotene (3,569 vs. 2,390 mcg), arid Vitamin C (101 vs. 78 mg) were observed in the active group, No other significant differences were observed for nutrient intakes between groups, although a trend toward higher amounts of Vitamin 13-12 (p = .056) and Vitamin B-6 (p = .06) were seen in the diets of the active compared with the inactive group.

The percentages of active and inactive participants who meet the recommended dietary guidelines for

Table 4. *Nutrient Intake by Activity Level.*

Nutrient	Inactive Mean ± SE	Active Mean ± SE	Significance p value
Total Calories	1882.94 ± 67.78	1854.04 ± 65.40	.77
Protein (g)	65.69 ± 2.78	70.73 ± 2.90	.24
Carbohydrate (g)	253.48 ± 9.81	247.61 ± 7.85	.64
Fat (g)	68.61 ± 3.13	67.07 ± 3.80	.77
Protein (%)	14.21 ± 0.40	15.75 ± 0.36	.006
Carbohydrate (%)	54.51 ± 0.95	55.19 ± 0.85	.60
Fat (%)	31.99 ± 0.76	29.99 ± 0.73	.07
Cholesterol (mg)	230.65 ± 16.87	218.66 ± 14.48	.60
Fiber (g/1000 kcal)	15.97 ± 0.91	17.06 ± 0.68	.33
Total Vitamin A (mcg)	792.47 ± 65.08	1052.94 ± 77.22	.018*
Beta-Carotene (mcg)	2390.70 ± 326.74	3568.93 ± 379.17	.031*
Vitamin C (mg)	78.40 ± 5.60	101.39 ± 6.67	.016*
Vitamin E (mg)	7.39 ± 0.41	7.91 ± 0.56	.50
Vitamin B6 (mg)	1.60 ± 0.01	1.81 ± 0.01	.09
Vitamin B12 (mcg)	3.28 ± .021	5.62 ± 1.20	.13
Folacin (mcg)	249.48 ± 15.85	286.47 ± 15.11	.11
Iron (mg)	13.78 ± 0.71	15.08 ± 0.74	.23
Calcium (mg)	706.12 ± 43.18	719.03 ± 30.64	.80
Zinc (mg)	8.92 ± 0.40	9.68 ± 0.51	.30

* p < .05

healthful diets are presented in Table 5. Active participants were more likely to meet dietary recommendations for Vitamin A (40% vs. 28%), Beta- Carotene (20% vs. 11%), and polyunsaturated fat (93% vs. 85%), Inactive participants were more likely to be achieving the recommendation for monounsaturated fats (75% vs, 59%). Although not statistically significant, as compared to inactive participants, active participants were more likely to meet dietary recommendations for total fat (50% vs. 42%, p = .09), saturated fat (52% vs, 43%, p = .08), and fiber (24% vs, 17%, P = .07).

Discussion

In this random sample, many of the nutrient intakes observed would increase the risk of developing several chronic diseases. Total fat intake approximates the guidelines, but a large proportion still do not consume diets with less than 30% of calories from fat or less than 10% from saturated fatty acids. Similar lack of adherence to fat recommendations was observed in the Framingham Heart population (14), Consumption of excess saturated fatty acids predict atherogenesis (3,15).

Low intakes of both Vitamin E E and folate are associated with increased incidence of cardiovascular disease (16,17), Inadeqauate consumption of either vitamin raises disease risk and could contribute to the high rates of cardiovascular disease observed in West Virginia, Calcium, which is concentrated in dairy products, could be a proxy for dairy food intake. Consumption of three nonfat daily products each day with eight servings of fruits and vegetables and low saturated fat lowers blood pressure, and thus potentially cardiovascular disease risk (18). The low calcium and

Table 5. ***Percentage of Active/Inactive Participants Who Met Recommendation for Healthful Diets.***

Nutrient	Inactive (n = 141) %	Active (n = 223) %	Odds Ratio	P value	(95% CI)
Protein (10-30% of kcal)	73	74	1.03	.51	0.64, 1.65
Carbohydrate (≥ 50% of kcal)	66	66	0.98	.51	0.63, 1.53
Total Fat (≤ 30% of kcal)	42	50	1.37	.09	0.90, 2.11
Saturated Fat (≤ 10% of kcal)	43	52	1.40	.08	0.91, 2.13
Polyunsaturated Fat (≤ 10% of kcal)	85	93	2.26	.015	1.41, 4.51
Monounsaturated Fat (10-20% of kcal)	75	59	0.49	.001	0.31, 0.78
Cholesterol (≤ 300 mg)	76	79	1.19	.29	0.72, 1.97
Sodium (≤ 3000 mg)	55	54	0.96	.47	0.63, 1.46
Dietary Fiber (≥ 25 gm)	17	24	1.56	.07	0.91, 2.67
Vitamin A (Men, ≥ 1000 μg RE; Women, ≥ 800 μg RE)	28	40	1.71	.013	1.09, 2.69
Beta Carotene (Men, ≥ 6000 gm; Women, ≥ 4800 gm)	11	20	1.98	.019	1.07, 3.65
Vitamin C (≥ 60 mg)	50	55	1.25	.18	0.82, 1.90
Vitamin E (Men, ≥ 10 mg α-tocopherol; Women, ≥ 8 mg α-tocopherol)	31	31	1.02	.51	0.65, 1.61
Vitamin B6 (Men, ≥ 2 mg; Women, ≥ 1.6 mg)	40	45	1.23	.20	0.80, 1.89
Vitamin B12 (≥ 2 μg)	68	64	0.84	.26	0.54, 1.31
Folate (Men, ≥ 200 μg Women, ≥ 180 μg)	50	57	1.33	.12	0.87, 2.05
Iron (All Men, ≥ 10 mg; Women over 50 yrs, ≥ 10 mg; Women under 50 yrs, ≥ mg)	49	48	0.95	.44	0.62, 1.44
Calcium (Under 50 yrs, ≥ 1000 mg; (Over 50 yrs, ≥ 1200 mg)	17	19	1.31	.39	0.65, 1.97
Zinc (Men, ≥ 15 mg; Women, ≥ 12 mg)	18	21	1.18	.32	0.69, 2.01

folate intakes observed suggest inadequate consumption of both nonfat dairy products and fruits and vegetables that are high in folate.

We hypothesized that individuals who are actively engaged in the recommended level of physical activity may also pursue healthier food choices. These data provide modest support for this hypothesis. Proportionally, the calories from protein were significantly higher ($p < .006$) and there was a trend (p '.07) for the kilocalories from fat to be lower in the active individuals. This inverse relationship between leisure-time physical activity and fat intake was also observed in the 1990 BRFSS data ($n = 29,672$)(19), In BRFSS, diet is assessed by questions of consumption of 13 high-fat foods; activity is assessed by the same questions we used in this study. With a larger sample, the differences in fat intake between the active and inactive groups would likely reach statistical significance.

Three other nutrients were significantly different between active and inactive groups. Individuals achieving the Surgeon General's physical activity recommendations for health consumed higher amounts of Vitamin A, Beta-carotene, and Vitamin C. Similar findings have recently been reported (20), Men and women with higher fitness levels consumed higher levels of these three nutrients as well as higher levels of other nutrients that we did riot observe (20). Fruits and vegetables are the primary dietary sources of Beta-carotene and Vitamin C.sources of Beta-carotene and Vitamin C. In a study with similar findings, Serdula (21) reported that active individuals consumed on average about one additional daily serving of fruits and vegetables. Total caloric content did not differ between groups. This suggests a more nutrient- dense diet in the active individuals. These data support the findings of others that report a modest "clustering" relationship between activity or fitness and diet behaviors (19-22), However, to our knowledge no one has ever used the Surgeon General's physical activity and diet recommendations to compare active and inactive individuals,

The present findings are limited in that the data are cross-sectional and self-reported, and we cannot discount That changes in these health behavíors that changes in these health behavíors may continue to evolve prospectively. For example, as one maintains a habitually active lifestyle, a gradual improvement in dietary behaviors may occur, Thus, the modest nutritional improvements among the active individuals observed in this study might lead to more substantial nutritional improvements as they continue to maintain an active lifestyle, A A prospective study would be needed to examine this issue.

The relationship between physical activity and dietary behaviors may have important implications for behavior change, The contribution of these two health behaviors to the development of chronic diseases has been estimated to account for nearly $1 trillion dollars in health care costs (23). Thus, a diet-and-exercise health promotion strategy may exert a greater influence on health outcomes than would a single-focus strategy targeting either behavior.

Conclusion

Reducing saturated fatty acids and increasing consumption of folate, Vitamin E, calcium and fiber are of prime public health importance in West Virginia. Dietary recommendations should focus on decreasing saturated fatty acids while increasing food sources of Vitamin E and folate, especially whole grains, fruits and vegetables rich in these nutrients. Additionally, low fat sources of calcium need to be increased, Achieving these dietary goals could markedly impact the incidence of cardiovascular disease, some cancers, and osteoporosis.

Diet and activity levels were modestly related, suggesting that those who adopt a healthy diet also become more active or vice versa. Due to the cross-sectional nature of this data, it is unknown if single- strategy or dual interventions work best, Prospective studies are needed to determine optimal strategies.

Acknowledgment

The authors appreciate the editorial assistance of Linda A. A. Lilly, M.A.

References

1. McGinnis JM Foege WH. Actual causes of death in United States. /AMA 1993;270:2207-12,

2. American College of Sports Medicine, The American Dietetic Association, International American Dietetic Association, International Food Information Council. For a healthful lifestyle: Promoting cooperation among nutrition professionals Find physical activity professionals. J Am Diet Assoc 1999; 99:994-7,

3. Committee on Diet and Health. Diet and Health: Implications of Reducing Chronic Disease Risk. Washington, DC: National Academy Press, 1989.

4. U.S, Department of Agriculture. Research Service, 1997, Data tables: results from USDA's I994-1996 Continuing Survey of Food Intakes by Individuals, 10: 1994-1996 Continuing Survey of Food lntakes by Individuals. CD-ROM,

5. McDowell M, Briefel , R, Alaimo K, Bischof A, Caughman C, Carroll M, et al. Energy and macronutrient intakes of persons ages 2 months and over in the United States: Third National Health and Nutrition Examination Survey, Phase I, 1988-91: CDC, No. 255. 1994

6. U.S. Department of Health and Human Services. Physical Activity und Health: A Report of the Surgeon General. Atlanta, GA; U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, National Center tor Chronic Disease Prevention and Health Promotion. 1996.

7. Federation of American Societies for Experimental Biology, Life Sciences Research Office. Prepared for the Interagency Board for Nutrition Monitoring and Related Research. 1995. Third Report on Nutrition Monitoring in the United States: Executive Summary. U.S. Government Printing Office, Washington. D.C.

8. U.S. Department of Health and Human Services. Healthy People 2000: National Health Promotion and Disease Prevention Objectives. Washington, DC: U.S. Department of Health and Human Services. Public Health Service, DHHS Publication No. (PHS) 91-50212, 1991.

9. WV Bureau for Public Health. 1998 Behavioral Risk Factors Survey: A report on the lifestyle behaviors affecting the health of West Virginia. Charleston, WV: State of West Virginia Department of Health and Human Resources Office of Epidemiology and Health Promotion.2000.

10. Consensus Workshop on Dietary Assessment: Nutrition Monitoring and Tracking the Year 200n Objectives. Wright JD, Ervin U, Btiefel RR. cds. National Center for Health Statistics. Hyattsville, MD, 1994.